CONWAY LAKE

1992

LAKES LAY MONITORING PROGRAM

by

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NEW HAMPSHIRE LAKES LAY MONITORING PROGRAM

NH LLMP

FRESHWATER BIOLOGY GROUP

University of New Hampshire

Durham

UNIVERSITY OF NEW HAMPSHIRE COOPERATIVE EXTENSION

Helping You To Put Knowledge And Research To Work

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PARAMETERS SAMPLED
NH LAKES LAY MONITORING PROGRAM

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PREFACE

This report contains the findings of a water quality survey of Conway Lake, New Hampshire, conducted in the summer of 1992 by the Freshwater Biology Group (FBG) of the University of New Hampshire and the Walker Pond Conservation Society.

The report is written with the concerned lake resident in mind and contains a brief, non-technical summary of 1992 results as well as more detailed "Introduction" and "Discussion" sections. Graphic display of data is included, in addition to listings of data in appendices, to aid visual perspective.

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ACKNOWLEDGEMENTS

This was the tenth year of participation in the Lakes Lay Monitoring Program (**LLMP**) for the Conway Lake monitors. The Lay Monitors of the lake were Nancy Earle, Hal and Marge Fisher and Sue West. The coordinator of the volunteer monitoring program on Conway Lake and liaison to the Freshwater Biology Group (**FBG**) was again Nancy Earle. The **FBG** congratulates the Lay Monitors on the quality of their work and the time and effort put forth. We encourage other interested members of the Walker Pond Conservation Society to continue monitoring during the 1993 season. Funding for the monitoring program was provided by the Walker Pond Conservation Society.

The Freshwater Biology Group is a not-for-profit research program co-supervised by Dr. Alan Baker and Dr. James Haney and coordinated by Jeffrey Schloss. Members of the **FBG** summer field team included Jeffrey Schloss, Robert Craycraft, Gregg Vereb, Gregg Stevens, Sean Proll, Matt Denneen and Robert Banks. Other **FBG** staff assisting in the fall were Eric Betke, Amanda Fifield, Jessica Chappell and Phil Lucason.

The **FBG** acknowledges the University of New Hampshire Cooperative Extension for funding and furnishing office, laboratory and storage space. The College of Life Sciences and Agriculture provided accounting support and the UNH Office of Computer Services provided computer time and data storage allocations.

Participating groups in the **LLMP** include: The New Hampshire Audubon Society, Derry Conservation Commission, Dublin Garden Club, Nashua Regional Planning Commission, Center Harbor Bay Conservation Commission, Governor's Island Club Inc., Little Island Pond Rod and Gun Club, Walker's Pond Conservation Society, United Associations of Alton, the Pemaquid Watershed Study Group, the associations of Baboosic Lake, Beaver Lake, Berry Bay, Big Island Pond, Bow Lake Camp Owners, Chesham Pond, Lake Chocorua, Crystal Lake, Cunningham Pond, Dublin Lake, Glines Island, Goose Pond, Great East Lake, Lake Kanasatka Watershed, Langdon Cove, Long Island

Landowners, Lovell Lake, Marchs Pond, Mascoma Lake, Mendum's Pond, Meredith Bay Rotary Club, Merrymeeting Lake, Milton Ponds Lake Lay Monitoring, Mirror Lake (Tuftonboro), Moultonbouro Bay, Lake Winnipesaukee, Naticook Lake, Newfound Lake, Nippo Lake, Peaporridge Pond, Perkins Pond, Pleasant Lake, Silver Lake (Hollis), Silver Lake (Harrisville), Silver Lake (Madison), Silver Lake (Tilton), Squam Lakes, Lake Sunapee, Sunset Lake, Lake Waukewan, Lake Winona, Wentworth Lake and the towns of Alton, Amherst, Enfield, Hollis, Madison, Merrimack, Strafford and Wolfeboro.

CONWAY LAKE

1992 NON-TECHNICAL SUMMARY

Monitoring was undertaken at Conway Lake by the volunteer monitors from June 3 through September 24, 1992. An in-depth analysis of the lake was undertaken by the FBG on July 14.

1) Water transparency at Conway Lake was high, the sign of a clear and unproductive lake, with the single exception of low water clarity readings taken on July 1. The low water transparencies corresponded to an abundance of pollen in the water column at the time of sampling, which likely resulted in the atypically low water clarity. When measured the following week (on July 8), at which time the pollen had sunk to the lakebottom, the water clarity had increased from 2.4 meters in the lake to 6.2 meters, again suggesting the negative impact of sinking pine pollen on water clarity. The secchi disk depth increased in the ensuing weeks and reached a maximum depth of 7.8 meters (25.4 feet) on August 4. The seasonal transparency averages were 6.4 meters at site 1 Andrews and 6.3 meters at site 2 Gull in 1992. This indicates the deepwater sites on the lake contain low levels of dissolved color and suspended matter such as algae and particulates. The Average water clarity of Conway Lake was similar to the 1991 average water clarity (see figures 13 and 15).

2) Chlorophyll *a* concentrations (an indicator of microscopic plant abundance) in the surface waters of Conway Lake were low in 1992. Concentrations in the mixed layer of water averaged 2.0 milligrams per cubic meter (2.0 mg m^{-3} equivalent to about 2.0 parts chlorophyll per billion parts water) at site 1 Andrews and 1.7 mg m^{-3} at site 2 Gull. The 1992 average chlorophyll *a* concentration was low and typical of an unproductive New

Hampshire lake. The average chlorophyll *a* concentration was lower than the 1991 average concentration (see figure 12 and 14).

3) Dissolved lakewater color levels for Conway Lake were low to moderate in 1992, 21.0 ptu (platinate color units), and slightly lower than the average levels of 26 ptu in other program lakes. Small increases in water color from the natural breakdown of plant materials in and around a lake are not considered to be detrimental to water quality. However, increased color can lower water transparency, and hence, change the public perception of water quality. Large amounts of dissolved color may occur naturally but also occur during deforestation and development within the watershed. High color levels can actually mask the ability of the secchi disk transparency to predict chlorophyll levels.

4) Total phosphorus (nutrient) levels were low in the surface and bottom waters of both sampling stations when sampled by the FBG on July 14 and ranged from 1.3 to 4.4 parts per billion (ppb). However, the bottom waters did exhibit an increase in nutrient levels, relative to the surface waters, which suggests the release of nutrients from decaying organic matter in the deeper waters. Tributary samples collected by the volunteer monitors were low to moderate in 1992. The highest nutrient levels occurred at the Page Brook and reached a moderate concentration of 14.6 ppb. With the exception of the higher phosphorous level at the Page Brook, all phosphorous samples remained well within the concentration of 15 ppb which is considered the boundary between less productive and more productive lakes.

5) The pH of the surface waters of the lake, measured by the FBG, remains within the optimum range for most aquatic organisms. The alkalinity of the lake, the lakes ability to buffer acid input, remains low, about 3 units lower than the average of 6.3 units for LLMP lakes. The alkalinity data indicate that Conway Lake seems to have a low, but sufficient,

buffering capacity at this time to resist fluctuations in pH due to acid loadings. Note: Alkalinity readings collected on July 8 and July 21 were omitted as the alkalinity titrant was no good. Subsequent alkalinity readings were collected using new alkalinity titrant and alkalinity indicator, supplied by the FBG, and are included in the data listing (see appendix A).

6) The specific conductivity of the deep sites on Conway Lake was low, ranging from 31.3 to 33.4 micro-Siemans. High conductivity values can indicate the presence of septic leachate or deicing road salt runoff.

7) Temperature profiles collected by the volunteer monitors disclosed the typical temperature stratification patterns for northern temperate lakes. With the depth of the upper mixed layer extending to 6.0 meters. Oxygen content of the bottom waters remained above 5 milligrams per liter (the minimum concentration required for successful reproduction and growth of most coldwater fish) to the lakebottom of both deep sampling stations, 1 Andrews and 2 Gull. However, high carbon dioxide and declining oxygen levels in the bottom waters of site 1 Andrews suggest the accumulation of organic matter from algal and plant productivity as well as watershed runoff. Previous sampling by the FBG indicates the deeper waters of this site become depleted of oxygen as the season progresses (i.e. oxygen concentrations drop below the concentration of 5 milligrams per liter).

8) For all measurements considered and averaged for the season, Conway Lake would be classified as an unproductive, clear, oligotrophic lake. However, the oxygen levels are more typical of a moderately productive lake which suggest a higher level of lake productivity than is indicated by the chlorophyll and water clarity measurements.

9) Comparisons between the FBG and lay monitors of Conway Lake indicate the volunteers are doing an excellent job of measuring water quality at both deep sampling stations.

COMMENTS AND RECOMMENDATIONS

1) We recommend that each participating association, including the Walker Pond Conservation Society, continue to develop its data base on lake water quality through continuation of the long term monitoring program. The data base will provide information on the short and long-term cyclic variability that occurs in the lake and eventually will enable more reliable predictions of water quality trends.

2) With the heavy snowfall this winter, we expect some substantial runoff this spring and recommend collecting nutrient (phosphorous) samples as well as taking alkalinity readings during this critical time. Both tributary and in-lake samples are suggested.

In addition to collecting phosphorous samples, the volunteers should also make a note of the conditions of the tributaries during the time of sampling (i.e. does the stream have a foul odor, is the water laden with sediments, is the stream flowing heavily during this time?). This will help identify any potential problem areas and allow us to structure a monitoring scheme to address the particular concern.

3) Increased nutrient levels in the hypolimnion (bottom layer of water) suggest an accumulation of nutrients as the season progresses and the possibility of internal nutrient loading. We recommend collecting phosphorous samples at the deep sampling stations of Conway Lake to determine the degree of this phenomenon, as increased nutrient loading can result in elevated algal levels, particularly in the spring and fall when the lake undergoes **overturn** (the lake circulates mixing the bottom and surface waters and allows resuspension of nutrients within the water column).

INTRODUCTION

The New Hampshire Lakes Lay Monitoring Program

In this fifteenth year of operation, the NH Lakes Lay Monitoring Program has grown from a university class project on Chocorua Lake and pilot study on the Squam Lakes to a comprehensive state-wide program with over 500 volunteer monitors and more than 100 lakes participating. Originally developed to establish a data-base for determining long-term trends of lake water quality for science and management, the program has expanded by taking advantage of the many resources that citizen monitors can provide. The NH LLMP has an international reputation as a successful cooperative monitoring, education and research program. Current projects include: use of volunteer generated data for non-point pollution studies using high tech analysis system (Geographic Information Systems and Satellite Remote Sensing), intensive watershed monitoring for the development of lake nutrient budgets, and investigations of water quality and indicator organisms (food web analysis, fish condition, and stream invertebrates). The key ingredients responsible for the success of the program include innovative funding and cost reduction, assurance of credible data, practical sampling protocols and, most importantly, the interest and motivation of our volunteer monitors.

The 1992 sampling season was another exciting year for the New Hampshire Lakes Lay Monitoring Program. National recognition for the high quality of work by you, the volunteer monitors, continued with awards, requests for program information and invitations to speak at national conferences. We continue to be listed as a model citizen monitoring program on the Environmental Success Index of Renew America and on the Environmental Network Clearinghouse. To date, the approach and methods of the NH LLMP have been adopted by new or existing programs in fifteen states and nine countries!

Our Fish Condition Program intensive lake survey results have been tabulated, reports went to NH Fish & Game (our sponsor) and the results for individual lakes are forthcoming. Our fish study team is now focusing on the Newfound Lake fishery to determine the effects and results of alewife introduction.

In 1992 volunteers performed over 3000 measurements on lakes across the state as well as provided over 2000 samples that were analyzed in our UNH Freshwater Biology Group analytical lab. To date, data has been collected on over 100 lakes at over 440 sites by almost 600 volunteers who made over 10,492 lake sampling trips!

The General Scenario- 1992

Low snow pack (less water melting through the watershed at springtime) was again a factor in reduced spring runoff although we did see a handful of spring shower events early in the season. While mid and late summer conditions were more cloudy than typical, rainfall was again light. Thus, while not as dry as the summer of 1991, the 1992 summer season had below average precipitation. The general result of this was continued optimum water quality conditions for most lakes.

Lakes were clearer due to a combination of factors that could include lower dissolved color washed in from surrounding wetland areas, lower algae growth (measured as chlorophyll a) in the surface waters and lower suspended sediment levels. Dissolved color is not indicative of a water quality problems (although large increases in dissolved color sometime follow large land clearing operations) but in some of our more pristine program lakes it nevertheless has a large effect on water clarity changes.

With decreased nutrient runoff in the spring, and a lower water table situation translating into less of a chance of septic system failure, algae and some aquatic plant growth would be minimized.

As with color and nutrients the dryer season brought less suspended sediment load to many of our streams and lakes. If increased clarity was not the result of decreased color or chlorophyll levels then it was due to decreased suspended sediment by default. To find out how these water quality indicators inter-relate for a particular lake site compare the secchi disk, chlorophyll and color graphs enclosed in this report. Note whether changes in clarity (secchi disk depth) correspond to chlorophyll or color concentration changes or whether it is a combination of both. If neither seem to exhibit a consistent effect then sediment plays an important role in your lake's clarity.

A few NH LLMP lakes were actually worse off in 1992. These lakes included those more productive lakes in which a good deal of nutrients come internally from sediment release. Lakes with significant nutrient input from septic systems or shoreline fertilization and watering would also have a bad year under the 1992 conditions. Other lakes that fared worse this year were seepage lakes, shallow lakes that rely on groundwater (springs) in-flow and out-flow for replenishment and cleansing. With a low water table, these lakes became great "growth chambers" for algae.

Importance of Long-term Monitoring

A major goal of a monitoring program is to identify any short or long-term changes in the water quality of the lake. Of major concern is the detection of cultural eutrophication: increases in the productivity of the lake, the amount of algae and plant growth, due to the addition of nutrients from human activities. Changes in the natural buffering capacity of the lakes in the program is also a topic of great concern, as New Hampshire receives large amounts of acid precipitation, yet most of our lakes contain little mineral content to neutralize this type of pollution.

For almost a decade and a half, data collected weekly from lakes participating in the **New Hampshire Lakes Lay Monitoring Program** have indicated there is quite a variation in water quality indicators through the open water season on the majority of lakes. Short-term differences may be due to variations in weather, lake use, or other chance events. Monthly sampling of a lake during a single summer provides some useful information, but there is a greater chance that important short-term events such as algal blooms or the lake response to storm run-off will be missed. These short-term fluctuations may be unrelated to the actual long-term trend of a lake or they may be indicative of the changing status or "health" of a lake.

To determine if a change in water quality is occurring, a lake must be sampled on a frequent basis over a substantial amount of time. A poorly designed sampling program may even mislead the investigator away from the actual trend: Consider the hypothetical lake in Figure 1. Sampling only once a year during August from 1982 to 1986 would produce a plot (Fig. 2) suggesting a decrease in eutrophication. The actual long-term trend of the lake, increasing eutrophy, can only be clearly discerned by sampling additional times a year for a ten year period (Fig. 1). Frequent monitoring carried out over the course of many summers can provide the information required to distinguish between short-term fluctuation ("noise") and long-term trends ("signal"). To that end, the lake must establish a long-term data base.

The number of seasons it takes to distinguish between the noise and the signal is not the same for each lake. Evaluation and interpretation of a long-term data base will indicate that the water quality of the lake has worsened, improved, or remained the same. In addition, different areas of a lake may show a different response. As more data is collected, prediction of current and future trends can be made. No matter what the outcome, this information is essential for the intelligent management of the lake.

There are also short-term uses for lay monitoring data. The examination of different stations in a lake can disclose the location of specific problems and corrective action can be initiated to handle the situation before it becomes more serious. On a lighter note, some associations post their weekly data for use in determining the best depths for finding fish!

It takes a considerable amount of effort as well as a deep concern for one's lake to be a lay monitor in the NH Lakes Lay Monitoring Program. Many times a monitor has to brave inclement weather or heavy boat traffic to collect samples. Sometimes it even may seem that one week's data is just the same as the next. Yet every sampling provides important information on the variability of the lake.

We are pleased with the interest and commitment of our lay monitors and are proud that their work is what makes the NH LLMP the most extensive, and we believe, the best volunteer program of its kind.

Purpose and Scope of This Study

This was the tenth year that monitoring of Conway Lake was undertaken by the Freshwater Biology Group and the Walker Pond Conservation Society. The program of sampling was designed to continue adding data to the long-term data base established. Sampling emphasis was placed on two open water deep stations while additional phosphorous (nutrient) samples were collected in the tributaries. An in-depth study of the deep lake sites was undertaken by the FBG on July 14.

The primary purpose of this report is to discuss results of the 1992 monitoring with emphasis on current conditions of Conway Lake including the extent of eutrophication and the lake's susceptibility to increasing acid precipitation. This information is part of a large data base of historical and more recent data compiled and entered onto computer files for New Hampshire lakes that include New Hampshire Fish and Game surveys of the 1930's, the surveys by the New Hampshire Water Supply and Pollution Control Commission and the FBG surveys. Care must be taken when comparing current results with early studies.

Many complications arise due to methodological differences of the various testing facilities and technological improvements in testing.

DISCUSSION OF LAKE MONITORING MEASUREMENTS

The section below details the important concepts involved for the various testing procedures used in the New Hampshire Lakes Lay Monitoring Program. Where appropriate, summary statistics of 1992 results from all participating lakes are included. Certain tests or sampling performed at the time of the optional Freshwater Biology Group field trip are indicated by an asterisk (*).

Thermal Stratification in the Deep Water Sites

Lakes in New Hampshire display distinct patterns of temperature stratification, that develop as the summer months progress, where a layer of warmer water (the **epilimnion**) overlies a deeper layer of cold water (**hypolimnion**). The layer that separates the two regions characterized by a sharp drop in temperature with depth is called the **thermocline** or **metalimnion**. Some shallow lakes may be continually mixed by wind action and will never stratify. Other lakes may only contain a developed epilimnion and metalimnion.

Conway Lake became stratified into three distinct layers (discused above) as the season progressed.

Water Transparency

Secchi Disk depth is a measure of the water transparency. The deeper the depth of secchi disk disappearance, the more transparent the lake water; light penetrates deeper if there is little dissolved and/or particulate matter (which includes both living and non-living particles) to absorb and scatter it.

In the shallow areas of many lakes, the secchi disk will hit bottom before it is able to disappear from view (what is referred to as a "Bottom Out" condition). Thus, Secchi disk measurements are generally taken over the deepest sites of a lake. Transparency values of greater than 4 meters are typical of clear, less productive lakes. Values less than 2.5

meters are generally an indication of a very productive lake. In 1992 the average transparency for lakes participating in the NH LLMP was 5.6 meters with a range of 1.8 to 12.5 meters.

Secchi disk readings collected at Conway Lake in 1992 were high through most of the sampling season and averaged 6.4 meters (range: 2.2 to 7.8 meters) at site A and 6.3 meters (range: 2.4 to 7.8 meters) at site 2 Gull. The lowest water clarity corresponded to an abundance of pollen in the water column on July 14, but returned to normal in the ensuing weeks when the pollen settled out of the water column (see figures 4 and 7).

Chlorophyll a

The chlorophyll a concentration is a measurement of the standing crop of phytoplankton and is often used to classify lakes into categories of productivity called trophic states. **Eutrophic** lakes are highly productive with large concentrations of algae and aquatic plants due to nutrient enrichment. Characteristics include accumulated organic matter in the lake basin and lower dissolved oxygen in the bottom waters. Summer chlorophyll a concentrations average above 7 mg m^{-3} (7 milligrams per cubic meter; 7 parts per billion). **Oligotrophic** lakes have low productivity and low nutrient levels and average summer chlorophyll a concentrations are generally less than 3 mg m^{-3}. These lakes generally have cleaner bottoms and high dissolved oxygen levels throughout. **Mesotrophic** lakes are intermediate in productivity with concentrations of chlorophyll a generally between 3 mg m^{-3} and 7 mg m^{-3}. In 1992 the average chlorophyll for lakes participating in the NH LLMP was 2.8 mg m^{-3} with a range of 0.4 to 18.5 mg m^{-3}.

Surface water chlorophyll *a* levels in Conway Lake were low in 1992 and averaged 2.0 mg m^{-3} (range: 1.5 to 2.9 mg m^{-3}) at site 1 Andrews and averaged 1.7 mg m^{-3} (range: 0.9 to 2.7 mg m^{-3}) at site 2 Gull. The average chlorophyll *a* concentration decreased for the second year in a row at both deep sampling stations in 1992. While chlorophyll a levels have decreased over the past two seasons, the change is likely the response to the atypically dry seasons over the past two sampling seasons, resulting in minimal nutrient input to stimulate algal growth, and not to changing practices within the watershed. As 1993 is off to a wet start, it is likely the lake will demonstrate a higher level of productivity than that seen over the past two seasons.

Testing is sometimes done to check for **metalimnetic algal populations**, algae that layer out at the thermocline and generally go undetected if only epilimnetic (point or integrated) sampling is undertaken. Chlorophyll concentrations of a water sample collected in the thermocline is compared to the integrated epilimnetic sample. Greater chlorophyll levels of the point sample, in conjunction with microscopic examination of the samples (see Phytoplankton section below), confirm the presence of such a population of algae. These populations should be monitored as they may be an indication of increased nutrient loading into the lake.

A higher mid-lake chlorophyll *a* level at site 1 Andrews suggest the stratification of algae in the thermocline. The chlorophyll a concentration was nearly twice as high at mid-lake depth (4.1 mg m^{-3}) relative to the corresponding surface water sample (2.4 mg m^{-3}) when collected by the FBG on July 14. We suggest continued monitoring of this phenomenon late in the season as it may be a response to elevated nutrient levels in the bottom waters (hypolimnion).

Dissolved Color

The dissolved color of lakes is generally due to dissolved organic matter from **humic substances**, which are naturally-occurring polyphenolic compounds leached from decayed vegetation. Highly colored or "stained" lakes have a "tea" color. Such substances generally do not threaten water quality except as they diminish sunlight penetration into deep waters. Increases in dissolved watercolor can be an indication of increased development within the watershed as many land clearing activities (construction, deforestation, and the resulting increased run-off) add additional organic material to lakes. Natural fluctuations of dissolved color occur when storm events increase drainage from wetlands areas within the watershed. As suspended sediment is a difficult and expensive test to undertake, both dissolved color and chlorophyll information is important when interpreting the secchi disk transparency.

Dissolved color is measured on a comparative scale that uses standard chloroplatinate dyes and is designated as a color unit or ptu. Lakes with color below 10 ptu are very clear, 10 to 20 ptu are slightly colored, 20 to 40 ptu are lightly tea colored, 40 to 80 ptu are tea colored and greater than 80 ptu indicates highly colored waters. Generally the majority of New Hampshire lakes have color between 20 to 30 ptu.

Total Phosphorus

Of the two "nutrients" most important to the growth of aquatic plants, nitrogen and phosphorus, it is generally observed that phosphorus is the more limiting to plant growth, and therefore the more important to monitor and control. Phosphorus is generally present in lower concentrations, and its sources arise primarily through human related activity in a watershed. Nitrogen can be fixed from the atmosphere by many bloom-forming blue-green bacteria, and thus it is difficult to control. The total phosphorus includes all dissolved phosphorus as well as phosphorus contained in or adhered to suspended particulates such as sediment and plankton. As little as 15 parts per billion of phosphorus in a lake can cause an algal bloom.

Generally, in the more pristine lakes, phosphorus values are higher after spring melt when the lake receives the majority of runoff from its surrounding watershed. The nutrient is used by the algae and plants which in turn die and sink to the lake bottom causing phosphorus to decrease as the summer progresses. Lakes with nutrient loading from human activities and sources (Agriculture, Sediment Erosion, Septic Systems, etc) will show greater concentrations of nutrients as the summer progresses or after major storm events. Circulation of nutrients from the bottom waters of more productive lakes in late fall can result in algal blooms.

Phosphorous samples collected in the surface and bottom waters of Conway Lake were low when sampled by the FBG on July 14 and ranged from 1.3 to 4.4 ppb. However, the phosphorous concentration increased towards the lakebottom suggesting the possibility of internal nutrient loading. Tributary samples, collected by the volunteer monitors, remained low on September 28 with the exception of the Page Brook sampling station which reached the moderate concentration of 14.6 ppb.

pH *

The pH is a way of expressing the acidic level of lake water, and is generally measured with an electrical probe sensitive to hydrogen ion activity. The pH scale has a range of 1 (very acidic) to 14 (very "basic" or alkaline) and is logarithmic (ie: changes in 1 pH unit reflect a ten times difference in hydrogen ion concentration). Most aquatic organisms tolerate a limited range of pH and most fish species require a pH of 5.5 or higher for successful growth and reproduction.

PH samples collected by the FBG on July 14 ranged from 6.4 to 6.6 units which is within the range of tolerance for most aquatic organisms. The lowest pH levels were recorded one meter off the lakebottom of Site 1 Andrews which suggests the accumulation of carbon dioxide at that depth. Analysis performed by the FBG confirmed the presence of high CO_2 levels near the lakebottom of site 1 Andrews.

Alkalinity

Alkalinity is a measure of the buffering capacity of the lake water. The higher the value the more acid that can be neutralized. Typically lakes in New Hampshire have low alkalinities due to the absence of carbonates and other natural buffering minerals in the bedrock and soils of lake watersheds.

Decreasing alkalinity over a period of a few years can have serious effects on the lake ecosystem. In a study on an experimental acidified lake in Canada by Schindler, gradual lowering of the pH from 6.8 to 5.0 in an 8-year period resulted in the disappearance of some aquatic species, an increase in nuisance species of algae and a decline in the condition and reproduction rate of fish. During the first year of Schindler's study the pH remained unchanged while the alkalinity declined to 20 percent of the pre-treatment value. The decline in alkalinity was sufficient to trigger the disappearance of zooplankton species, which in turn caused a decline in the "condition" of fish species that fed on the zooplankton.

The analysis of alkalinity employed by the **Freshwater Biology Group** includes use of a dilute titrant allowing an order of magnitude greater sensitivity and precision than the standard method. Two endpoints are recorded during each analysis. The first endpoint (grey color of dye; pH endpoint of 5.1) approximates low level alkalinity values, while the second endpoint (pink dye color; pH endpoint of 4.6) approximates the alkalinity values recorded historically, such as NH Fish and Game data, with the methyl-orange endpoint method.

The average alkalinity of lakes throughout New Hampshire is low, approximately 9 mg per liter (calcium carbonate alkalinity), while the average alkalinity of the lakes studied by the **Freshwater Biology Group** in the NH LLMP is approximately 6.3 mg per liter. When alkalinity falls below 2 mg per liter the pH of waters can greatly fluctuate. Alkalinity levels are most critical in the spring when acid loadings from snowmelt and run-off are high, and many aquatic species are in their early, and most susceptible, stages of their life cycle.

Alkalinity levels in Conway Lake are low and about 3 units lower than other LLMP lakes. However, the current alkalinity level is sufficient to buffer against variations in pH caused by acid precipitation.

Specific Conductivity *

The specific conductance of a water sample indicates concentrations of dissolved salts. Leaking septic systems and deicing salt runoff from highways can cause high conductivity values. Fertilizers and other pollutants can also increase the conductivity of the water. Conductivity is measured in micro**mhos** (the opposite of the measurement of resistance **ohms**) per centimeter, more commonly referred to as micro-Siemans.

Conductivity was low in Conway Lake, ranging from 31.3 to 33.2 micro-Siemans at site 1 Andrews and from 31.7 to 33.4 micro-Siemans at site 2 Gull.

Dissolved Oxygen and Free Carbon Dioxide *

Oxygen is an essential component for the survival of aquatic life. Submergent plants and algae take in free carbon dioxide and create oxygen through **photosynthesis** by day. **Respiration** by both animals and plants uses up oxygen continually and creates **carbon dioxide.** Dissolved oxygen profiles determine the extent of declining oxygen concentrations in the lower waters. High carbon dioxide values are indicative of low oxygen conditions and accumulating organic matter. For both gases, as the temperature of the water decreases, more gas can be dissolved in the water.

The typical pattern of clear, unproductive lakes is a slight decline in hypolimnetic oxygen as the summer progresses. Oxygen in the lower waters is important for maintaining a fit, reproducing, cold water fishery. Trout and salmon generally require oxygen concentrations above 5 mg per liter (parts per million) in the cool deep waters. On the other hand, carp and catfish can survive very low oxygen conditions. Oxygen above the lake bottom is important in limiting the release of nutrients from the sediments and minimizing the collection of undecomposed organic matter.

Bacteria, fungi and other **decomposers** in the bottom waters break down organic matter originating from the watershed or generated by the lake. This process uses up oxygen and produces carbon dioxide. In lakes where organic matter accumulation is high, oxygen depletion can occur. In highly stratified eutrophic lakes the entire hypolimnion can remain unoxygenated or **anaerobic** until fall mixing occurs.

The oxygen peaks occurring at surface and mid-lake depths during the day are quite common in many lakes. These characteristic **heterograde oxygen curves** are the result of the large amounts of oxygen, the by-product of photosynthesis, collecting in regions of high algal concentrations. If the peak occurs in the thermocline of the lake, metalimnetic algal populations (discussed above) may be present.

The bottom water oxygen content of Conway Lake remained high (above the concentration of 5 ppb) at both deep sampling stations when measured by the FBG on July 14. However, oxygen concentrations at site 1 Andrews were approaching the level of 5 ppb which suggests the accumulation of organic matter. High carbon dioxide levels in the bottom waters of site 1 Andrews further suggest the accumulation of decomposing matter.

<u>Underwater Light</u> *

Underwater light available to photosynthetic organisms is measured with an **underwater photometer** which is much like the light meter of a camera (only waterproofed !). The **photic zone** of a lake is the volume of water capable of supporting photosynthesis. It is generally considered to be delineated by the water's surface and the level where light is reduced, by the absorption and scattering properties of the lake water, to one percent of the surface intensity. The one percent depth is sometimes termed the **compensation depth.** Knowledge of light penetration is important when considering lake productivity and in studies of submerged vegetation. Discontinuity (abrupt changes in the slope) of the profiles could be due to metalimnetic layering of algae or other particulates (discussed above). The underwater photometer allows the investigator to measure light at depths below the Secchi disk depth to supplement the transparency information.

Light profiles collected by the FBG on July 14 indicate the photic zone of Conway Lake extended to about 8.7 meters at site 1 Andrews and to about 8.9 meters at site 2 Gull.

<u>Indicator Bacteria</u> *

Coliform bacteria in water indicate the possibility of fecal contamination. Although they are usually considered harmless to humans, they are much easier to test for than harmful pathogenic enteric bacteria (**Salmonella, Shigella** etc.) and viruses that may be present in fecal material. **Total coliform** includes all coliform bacteria which arise from the gut of animals or from vegetative materials. **Fecal coliform** are those specific organisms that inhabit the gut of warm blooded animals. Another indicator organism **Fecal streptococcus** (sometimes referred to as **enterococcus**) also can be monitored. The ratio of fecal coliform to fecal strep may be useful in suggesting the type of animal source responsible for the contamination. Desirable levels for a Class A water body is less than 50 total coliform organisms per 100 milliliters. If the coliform level rises above 150 organisms per 100ml swimming should be prohibited.

Ducks and geese are often a common cause of high concentrations of coliform at specific lake sites. While waterfowl are important components to the natural and aesthetic qualities of lakes that we all enjoy, it is poor management practice to encourage these birds by feeding them. The lake and surrounding area provides enough healthy and natural food for the birds and feeding them stale bread or crackers does nothing more than import additional nutrients into the lake and allows for increased plant growth. As birds also are a host to the parasite that causes "swimmers itch" waterfowl roosting areas offer a greater chance for infestation to occur. Thus while leaving offerings for our feathered friends is enticing, the results can prove to be detrimental to the lake system and to human health.

Phytoplankton *

The planktonic community includes microbial organisms that represent diverse life forms, containing photosynthetic as well as non-photosynthetic types, and including bacteria, algae, crustaceans and insect larvae (the zooplankton are discussed below in a separate section). Because planktonic algae or "phytoplankton" tend to undergo rapid seasonal cycles on a time scale of days and weeks, the levels of populations found should be considered to be most representative of the time of collection and not necessarily of other times during the ice-free season, especially the early spring and late fall periods.

The composition and concentration of phytoplankton can be indicative of the trophic status of a lake. Seasonal patterns do occur and must be considered. For example **diatoms**, tend to be most abundant in April-June and October-November, in the surface or epilimnetic layers of New Hampshire lakes. As the summer progresses, the dominant types might shift to **green algae** or **golden algae**. By late season **Blue-green bacteria** generally dominate. In nutrient rich lakes, nuisance green algae and/or bluegreen bacteria might dominate continually. After fall mixing diatoms might again be found to bloom.

Phytoplankton samples collected in the surface waters of Conway Lake were low to moderate in density and demonstrated a high diversity of algal forms which is generally considered indicative of healthy lake conditions. The lake was dominated by the small flagellated, golden algae, *Chrysochromulina* on the July 14 sampling date. This small algal form is readily ingested by the zooplankton population and is not of the nuisance variety. The primary algal classes represented in the surface waters were the Golden Algae, Diatoms and Cryptomanads, all of which are considered typical of New Hampshire Lakes.

Zooplankton *

There are three groups of zooplankton that are generally prevalent in lakes: the **protozoa**, **rotifers** and **crustaceans**. Most research has been devoted to the last two groups although protozoa may be found in substantial amounts. Of the rotifers and the crustaceans, time and budgetary constraints usually make it necessary to sample only the larger zooplankton (macrozooplankton; larger than 80 or 150 microns; 1 million microns make up a meter). Thus, zooplankton analysis is generally restricted only to the larger crustaceans. Crustacean zooplankton are very sensitive to pollutants and are commonly used to indicate the presence of toxic substances in water. The crustaceans can be divided into two groups, the **cladocerans** (which include the "water fleas") and the **copepods**.

Macrozooplankton are an important component in the lake system. The filter feeding of the herbivorous ("grazing") species may control the population size of selected species of phytoplankton. The larger zooplankton can be an important food source for juvenile and adult planktivorous fish. All zooplankton play a part in the recycling of nutrients within the lake.

As discussed above for phytoplankton, zooplankton undergo seasonal population cycles and the results discussed below are most representative of the collection dates and not necessarily of other times during the ice-free season, especially during the early spring and late fall.

The macrozooplankton density was low at both deep sampling stations, 1.9 and 5.9 animals per liter, at sites 1 Andrews and 2 Gull, respectively. The macrozooplankton community of Conway Lake was dominated by the herbivorous cladoceran, *Eubosmina*, at both deep sampling stations on July 14. The subdominant zooplankton was the cladoceran, *Diaphanosoma*, which is often indicative of more productive systems, as it feeds on bacteria (naturally occurring heterotrophic bacteria and not necessarily that of septic systems).

Fish Condition

As with the plankton discussed above, the health of the fish species of a lake will be indicative of the overall water quality. Condition is determined by comparing the length of the fish to its weight. As would be expected, the heavier the fish for its length, the better its condition will be. By also examining a scale collected from the fish under a microscope, the approximate age and growth history can also be determined.

REFERENCES

American Public Health Association.(APHA) 1985. Standard Methods for the Examination of Water and Wastewater 16th edition. APHA, AWWA, WPCF.

Baker, A.L. 1973. Microstratification of phytoplankton in selected Minnesota lakes. Ph. D. thesis, University of Minnesota.

Carlson, R.E. 1977. A trophic state index for lakes. Limnol. Oceanogr. 22:361-379.

Edmondson, W.T. 1937. Food conditions in some New Hampshire lakes. In: Biological survey of the Androscoggin, Saco and coastal watersheds. (Report of E.E. Hoover.) New Hampshire Fish and Game Commission, Concord, New Hampshire.

Forsberg, C. and S.O. Ryding. 1980. Eutrophication parameters and trophic state indices in 30 Swedish waste-water receiving lakes. Arch. Hydrobiol. 89:189-207

Gallup, D.N. 1969. Zooplankton distributions and zooplankton-phytoplankton relationships in a mesotrophic lake. Ph.D. Thesis, University of New Hampshire.

Haney, J.F. and D.J. Hall. 1973. Sugar-coated Daphnia: a preservation technique for Cladocera. Limnol. Oceanogr. 18:331-333.

Hoover, E.E. 1936. Preliminary biological survey of some New Hampshire lakes. Survey report no. 1. New Hampshire Fish and Game Department, Concord, New Hampshire.

Hoover, E.E. 1937. Biological survey of the Androscoggin, Saco, and coastal watersheds. Survey report no. 2. New Hampshire Fish and Game Department, Concord, New Hampshire.

Hoover, E.E. 1938. Biological Survey of the Merrimack watershed. Survey report no. 3. New Hampshire Fish and Game Department, Concord, New Hampshire.

Hutchinson, G.E. 1967. A treatise on limnology, vol. 2. John Wiley and Sons, New York.

Lind, O.T. 1979. Handbook of common methods in limnology. C.V. Mosby, St. Louis.

Lorenzen, M.W. 1980. Use of chlorophyll-Secchi disk relationships. Limnol. Oceanogr. 25:371-372.

New Hampshire Water Supply and Pollution Control Commission. 1981. Classification and priority listing of New Hampshire lakes. Staff report no. 121. Concord, New Hampshire.

Newell, A.E. 1977. Biological survey of the lakes and ponds in Sullivan, Merrimack, Belknap and Strafford Counties. Survey report no. 8b. New Hampshire Fish and Game Department, Concord, New Hampshire.

Schindler, D.W., et al. 1985. Long-term ecosystem stress: Effects of years of experimental acidification on a small lake. Science. 228:1395-1400.

Schloss, J.A., A.L. Baker and J.F. Haney. 1989. Over a decade of citizen volunteer monitoring in New Hampshire: The New Hampshire Lakes Lay Monitoring Program. Lake and Reservoir Management.

Sprules, W.G. 1980. Zoogeographic patterns in size structure of zooplankton communities with possible applications to lake ecosystem modeling and management. in W.C. Kerfoot ed. Evolution and Ecology of Zooplankton Communities. University Press of New England. Dartmouth. pp642-656.

Uttermohl, H. 1958. Improvements in the quantitative methods of phytoplankton study. Mitt. int. Ver. Limnol. 9:1-25.

U.S. Environmental Protection Agency. 1979. A manual of methods for chemical analysis of water and wastes. Office of Technology Transfer, Cincinnati. PA-600/4-79-020.

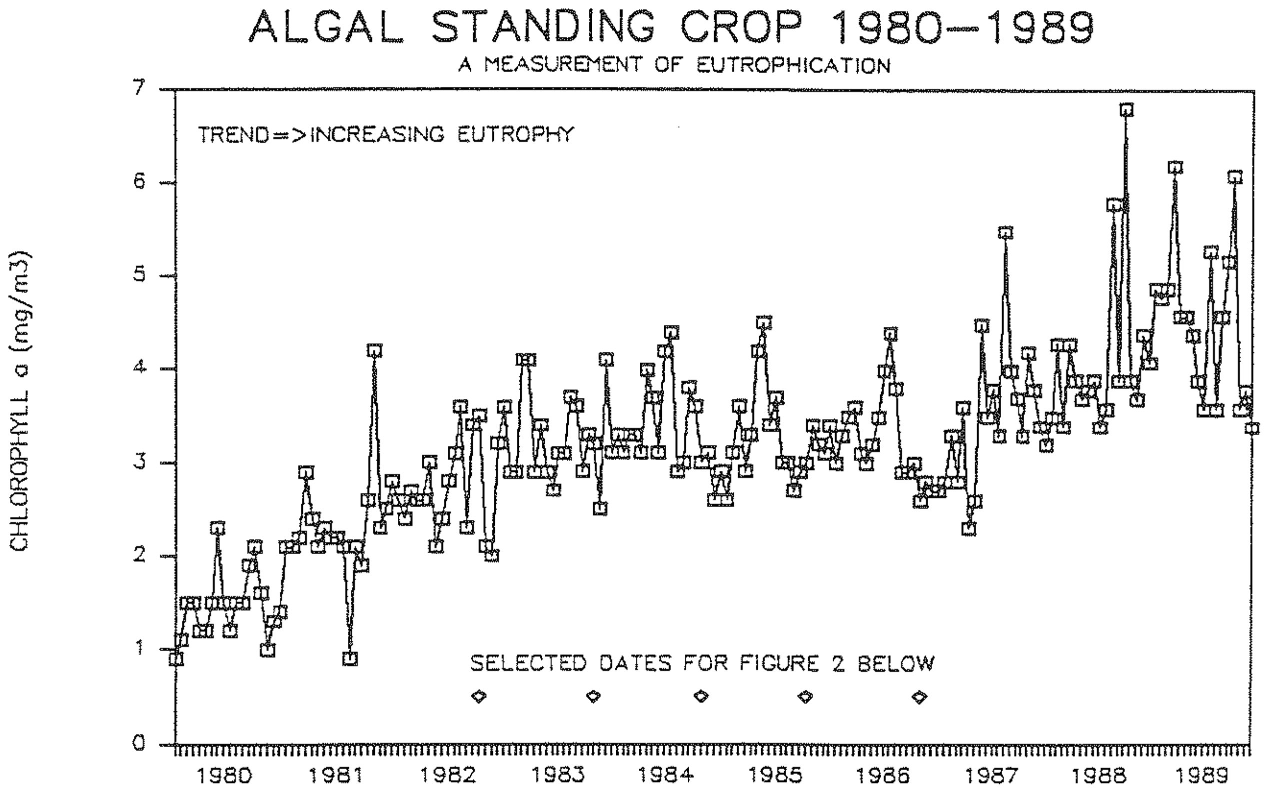
Vollenweider, R.A. 1969. A manual on methods for measuring primary productivity in aquatic environments. International Biological Programme. Blackwell Scientific Publications, Oxford.

Warfel, H.E. 1939. Biological survey of the Connecticut Watershed. Survey Report 4. N.H. Fish and Game. Concord, New Hampshire.

Wetzel, R.G. 1983. Limnology. Saunders College Publishing, Philadelphia.

Wetzel, R.G. and G.E. Likens. 1979. Limnological Analyses. W.B. Saunders Co. Philadelphia.

REPORT FIGURES



.Figure 1. The upper graph depicts weekly chlorophyll concentrations of a model lake measured weekly during ice-free conditions. The long-term trend is that of increased eutrophication (lake has become "greener"). Diamonds below the curve represent late summer (August) dates the data set was subsampled to create Figure 2.

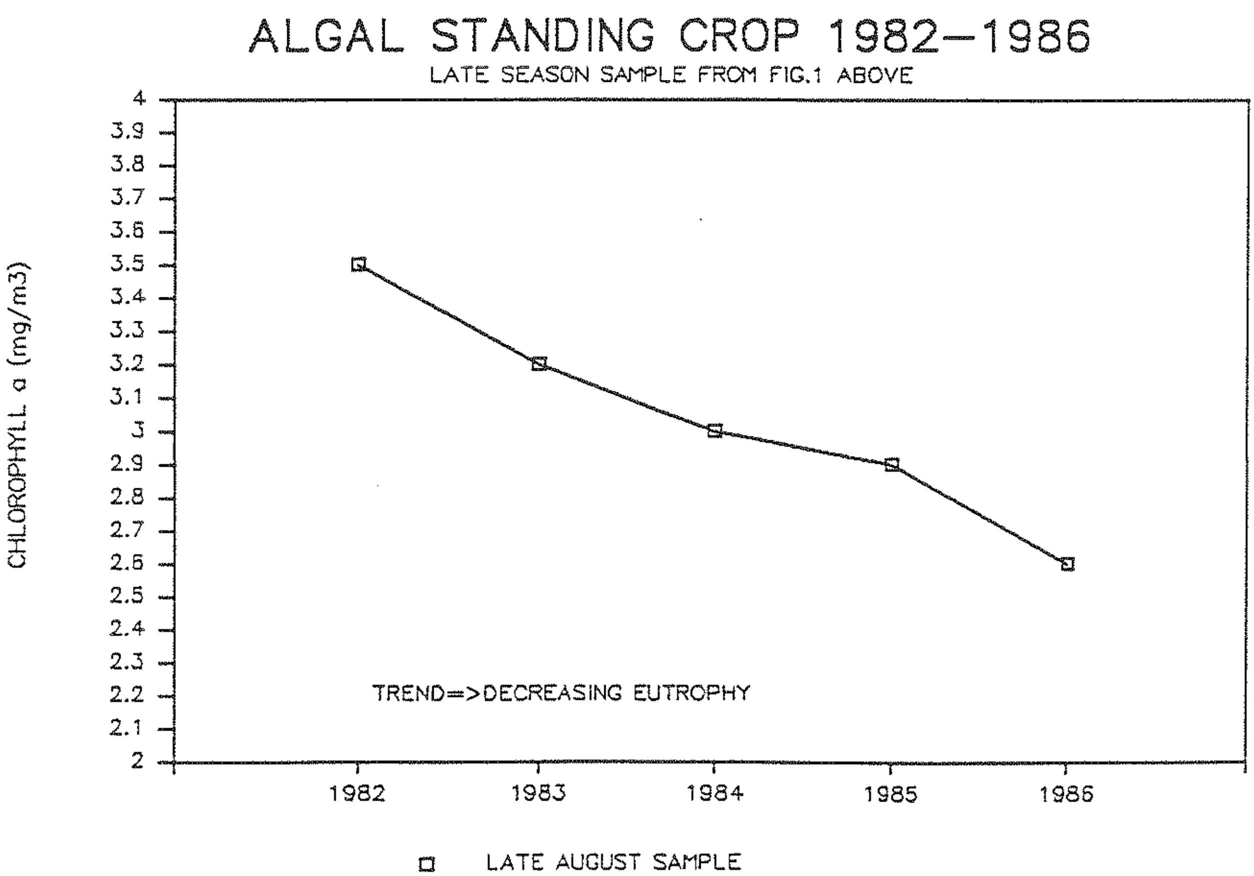
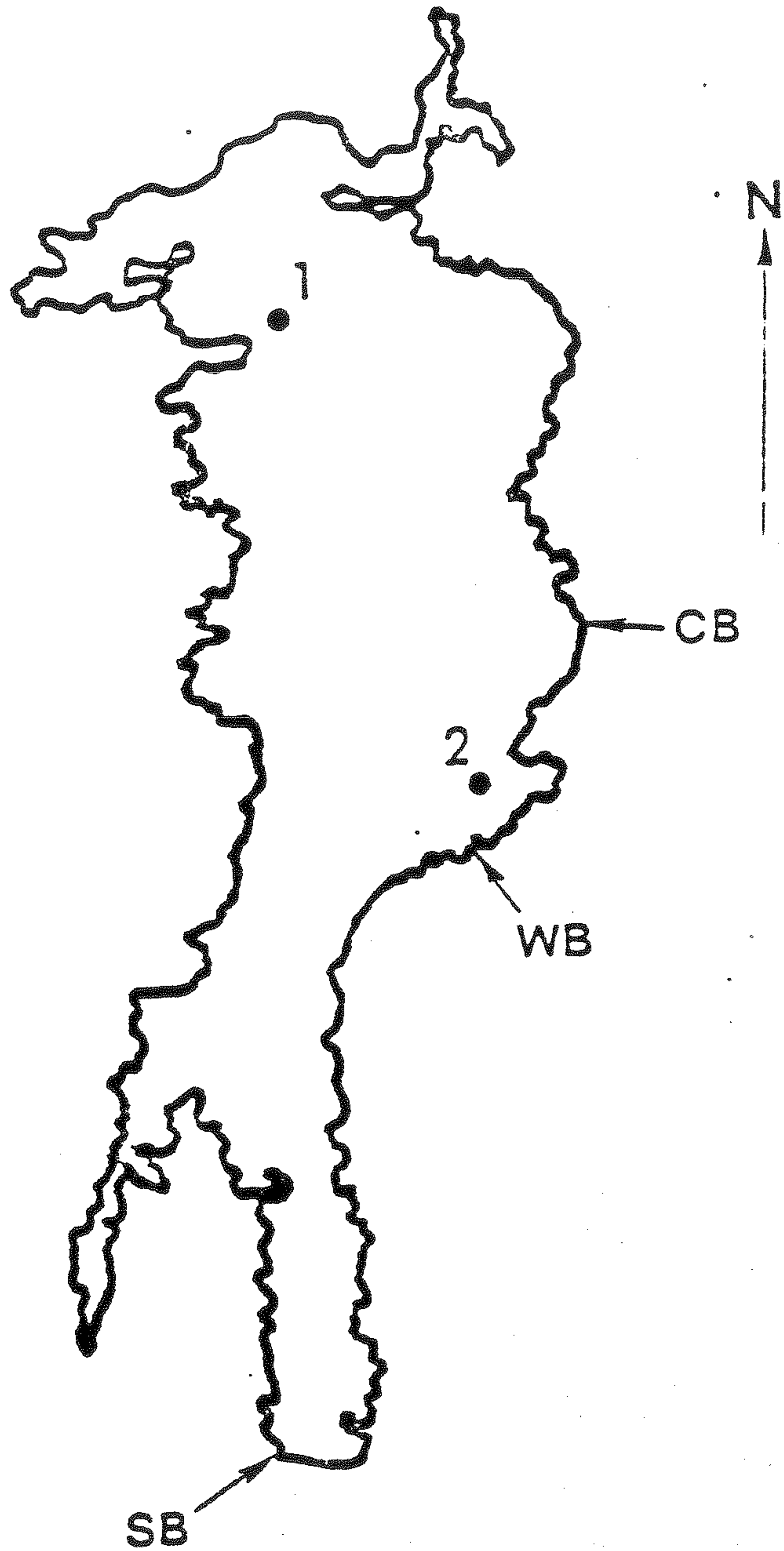


Figure 2. The lower graph depicts late summer chlorophyll data of the model lake in Figure 1. Note how limited sampling over a five year period suggests a much different trend, that of decreasing eutrophy. Thus, limited sampling can mislead the investigator of long-term trends.

Figure 3. Location of 1992 deep lake sampling stations (Site 1 Andrews and 2 Gull) for Conway Lake, New Hampshire.

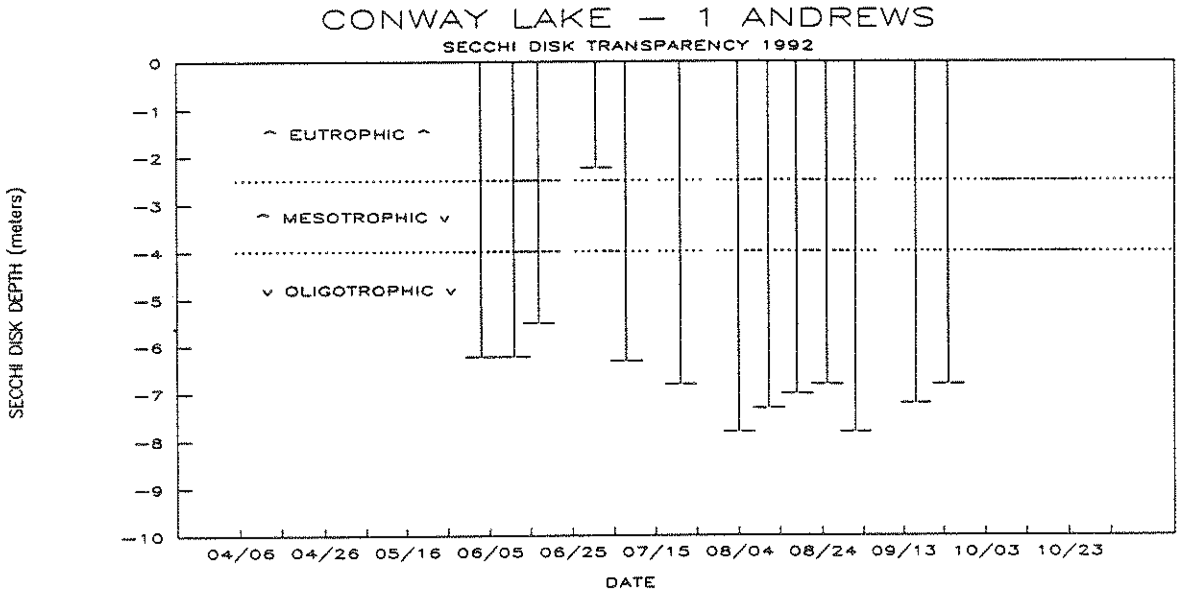


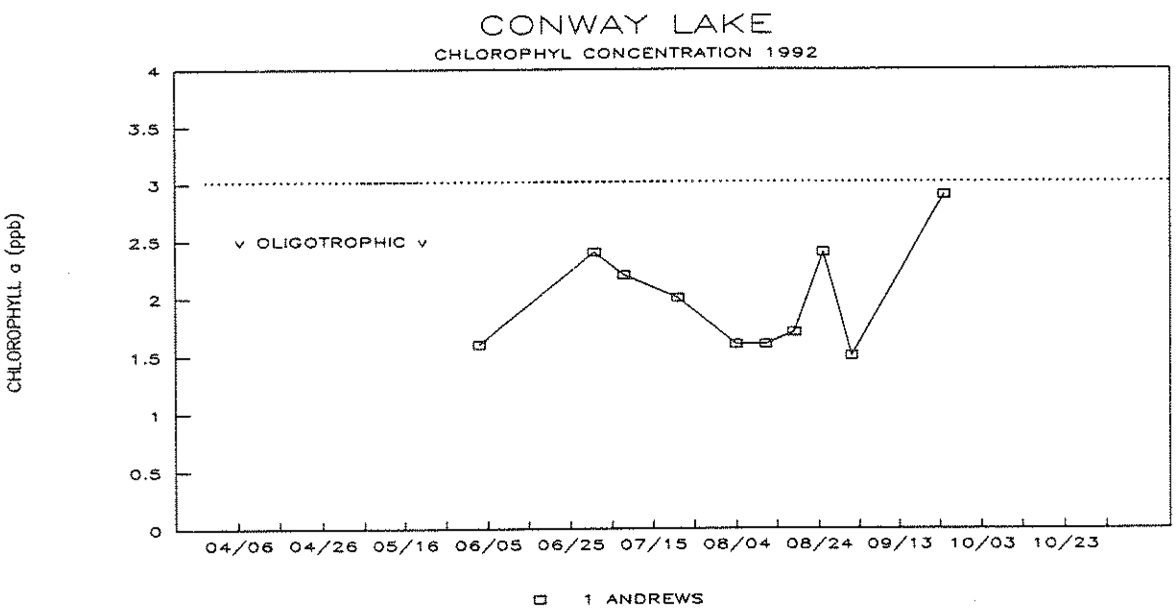
N
1
2
CB
WB
SB

Figure 4. Seasonal trends for Secchi Disk Depth (water transparency) 1992, Site 1 Andrews. Solid lines on the plots border the ranges common to oligotrophic, mesotrophic and eutrophic lakes.

Figure 5. Conway Lake 1992. Seasonal trends for chlorophyll *a* concentration of lay monitor Site 1 Andrews. Chlorophyll *a* concentrations in parts per billion (ppb) of chlorophyll *a*.

Figure 6. Conway Lake 1992. Seasonal trends for dissolved color concentration of lay monitor Site 1 Andrews. Color expressed as platinum-cobalt units (ptu).


CONWAY LAKE — 1 ANDREWS
SECCHI DISK TRANSPARENCY 1992
SECCHI DISK DEPTH (meters)
^ EUTROPHIC ^
^ MESOTROPHIC v
v OLIGOTROPHIC v
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
04/06 04/26 05/16 06/05 06/25 07/15 08/04 08/24 09/13 10/03 10/23
DATE


CONWAY LAKE
CHLOROPHYL CONCENTRATION 1992
CHLOROPHYLL a (ppb)
v OLIGOTROPHIC v
4
3.5
3
2.5
2
1.5
1
0.5
0
04/06 04/26 05/16 06/05 06/25 07/15 08/04 08/24 09/13 10/03 10/23
1 ANDREWS

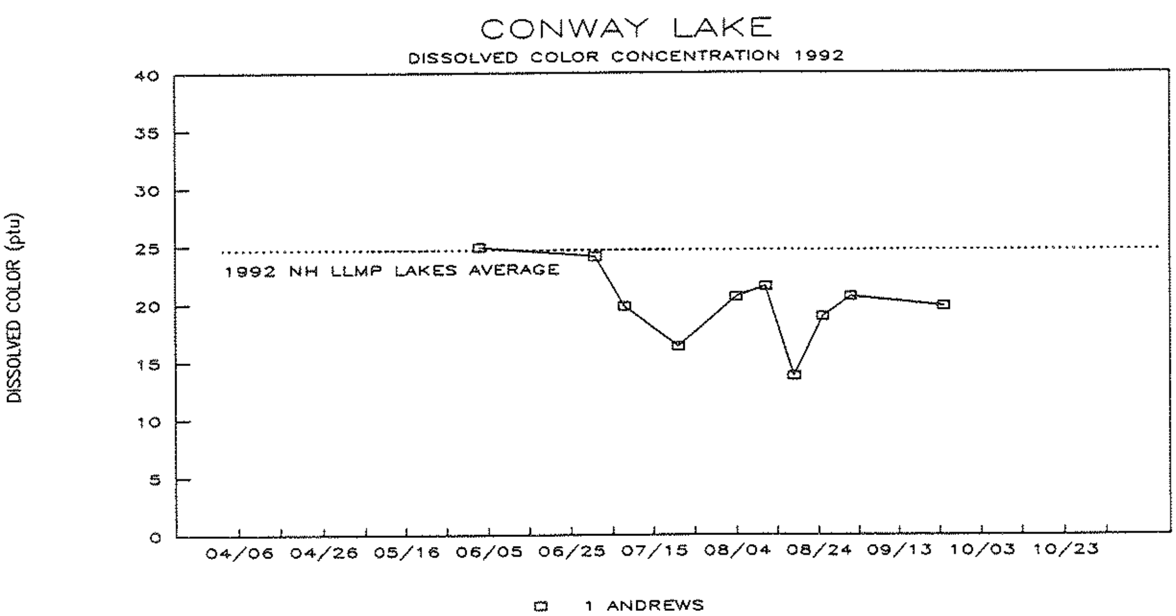
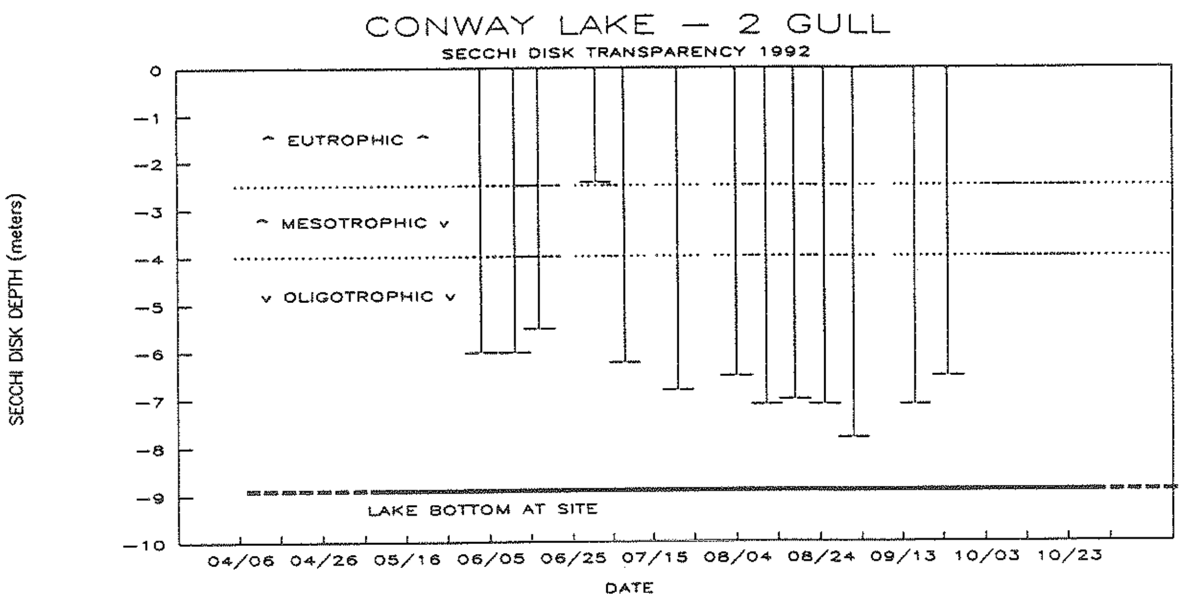
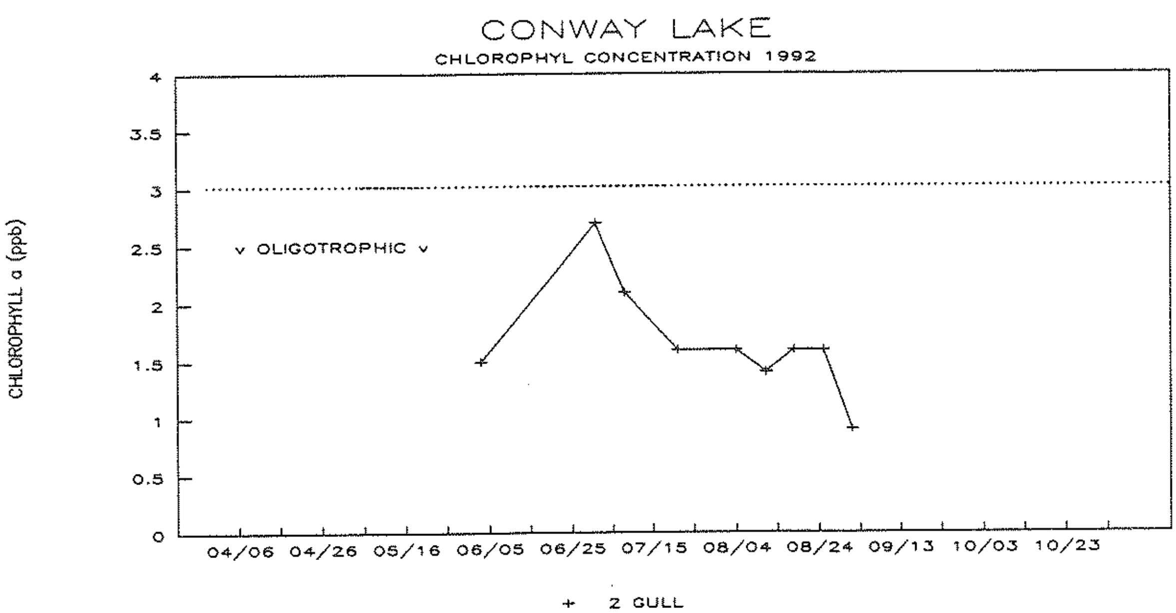

CONWAY LAKE
DISSOLVED COLOR CONCENTRATION 1992
DISSOLVED COLOR (ptu)
1992 NH LLMP LAKES AVERAGE
40
35
30
25
20
15
10
5
0
04/06 04/26 05/16 06/05 06/25 07/15 08/04 08/24 09/13 10/03 10/23
1 ANDREWS

Figure 7. Seasonal trends for Secchi Disk Depth (water transparency) 1992, Site 2 Gull. Solid lines on the plots border the ranges common to oligotrophic, mesotrophic and eutrophic lakes.

Figure 8. Conway Lake 1992. Seasonal trends for chlorophyll *a* concentration of lay monitor site 2 Gull. Chlorophyll *a* concentrations in parts per billion (ppb) of chlorophyll *a*.

Figure 9. Conway Lake 1992. Seasonal trends for dissolved color concentration of lay monitor site 2 Gull. Color expressed as platinum-cobalt units (ptu).


CONWAY LAKE — 2 GULL
SECCHI DISK TRANSPARENCY 1992
SECCHI DISK DEPTH (meters)
^ EUTROPHIC ^
^ MESOTROPHIC v
v OLIGOTROPHIC v
LAKE BOTTOM AT SITE
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
04/06 04/26 05/16 06/05 06/25 07/15 08/04 08/24 09/13 10/03 10/23
DATE


CONWAY LAKE
CHLOROPHYL CONCENTRATION 1992
CHLOROPHYLL a (ppb)
v OLIGOTROPHIC v
4
3.5
3
2.5
2
1.5
1
0.5
0
04/06 04/26 05/16 06/05 06/25 07/15 08/04 08/24 09/13 10/03 10/23
+ 2 GULL

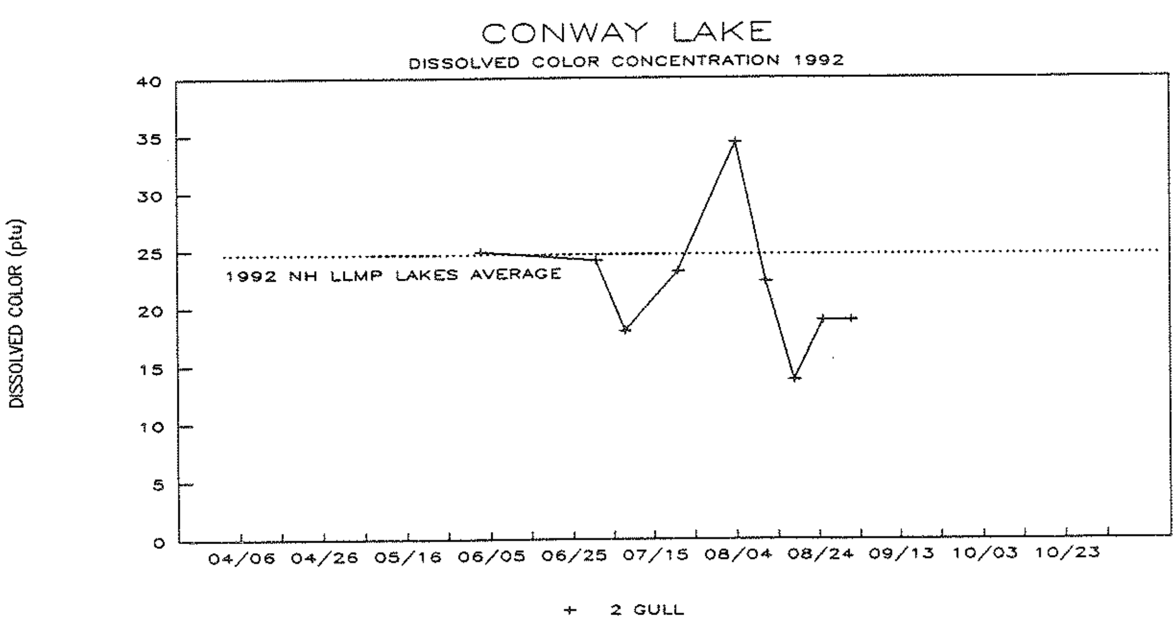
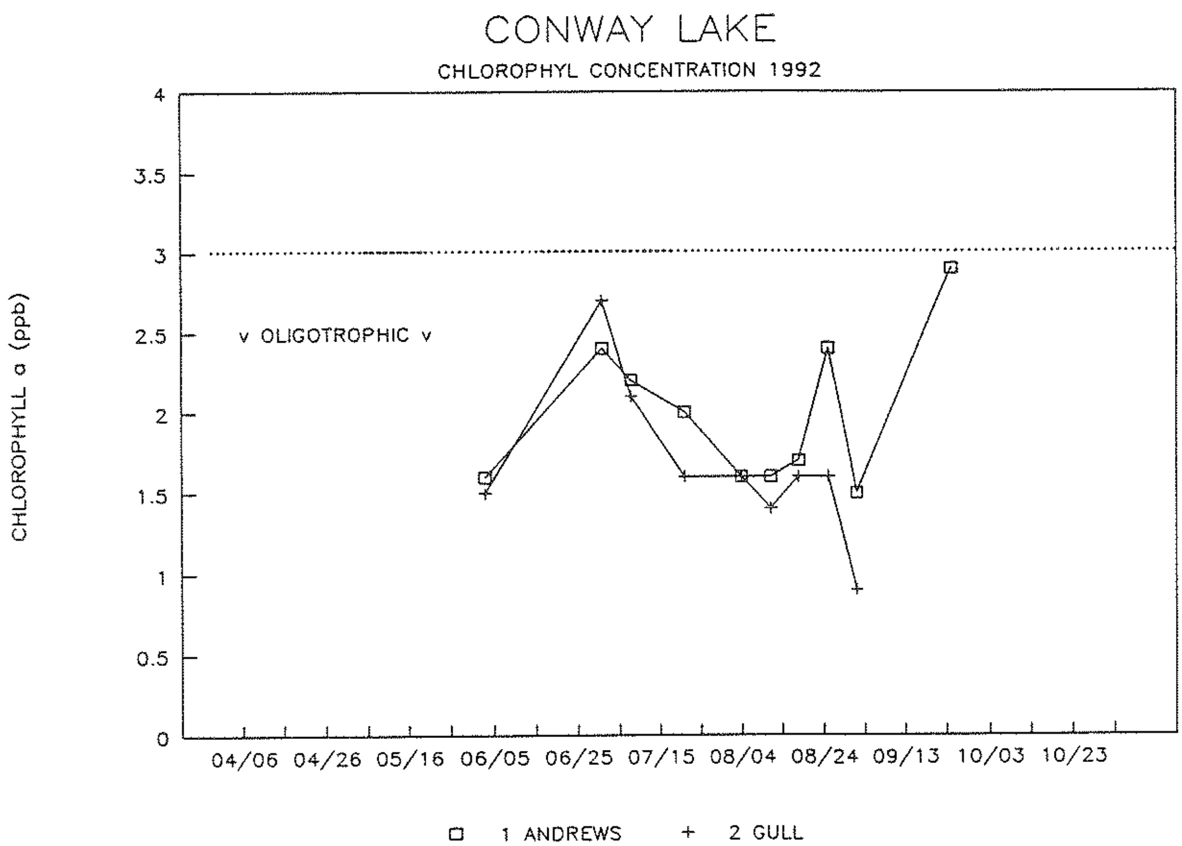

CONWAY LAKE
DISSOLVED COLOR CONCENTRATION 1992
DISSOLVED COLOR (ptu)
1992 NH LLMP LAKES AVERAGE
40
35
30
25
20
15
10
5
0
04/06 04/26 05/16 06/05 06/25 07/15 08/04 08/24 09/13 10/03 10/23
+ 2 GULL

Figure 10. Conway Lake 1992. Seasonal trends for chlorophyll *a* concentration of lay monitor sites 1 Andrews (squares) and 2 Gull (crosses). Chlorophyll *a* concentration in parts per billion (ppb) of chlorophyll *a*.

Figure 11. Conway Lake 1992. Seasonal trends for dissolved color concentrations of lay monitor sites 1 Andrews (squares) and 2 Gull (crosses). Color expressed as platinum-cobalt units (ptu).


CONWAY LAKE
CHLOROPHYL CONCENTRATION 1992
CHLOROPHYLL a (ppb)
4
3.5
3
2.5
2
1.5
1
0.5
0
v OLIGOTROPHIC v
04/06 04/26 05/16 06/05 06/25 07/15 08/04 08/24 09/13 10/03 10/23
1 ANDREWS
2 GULL

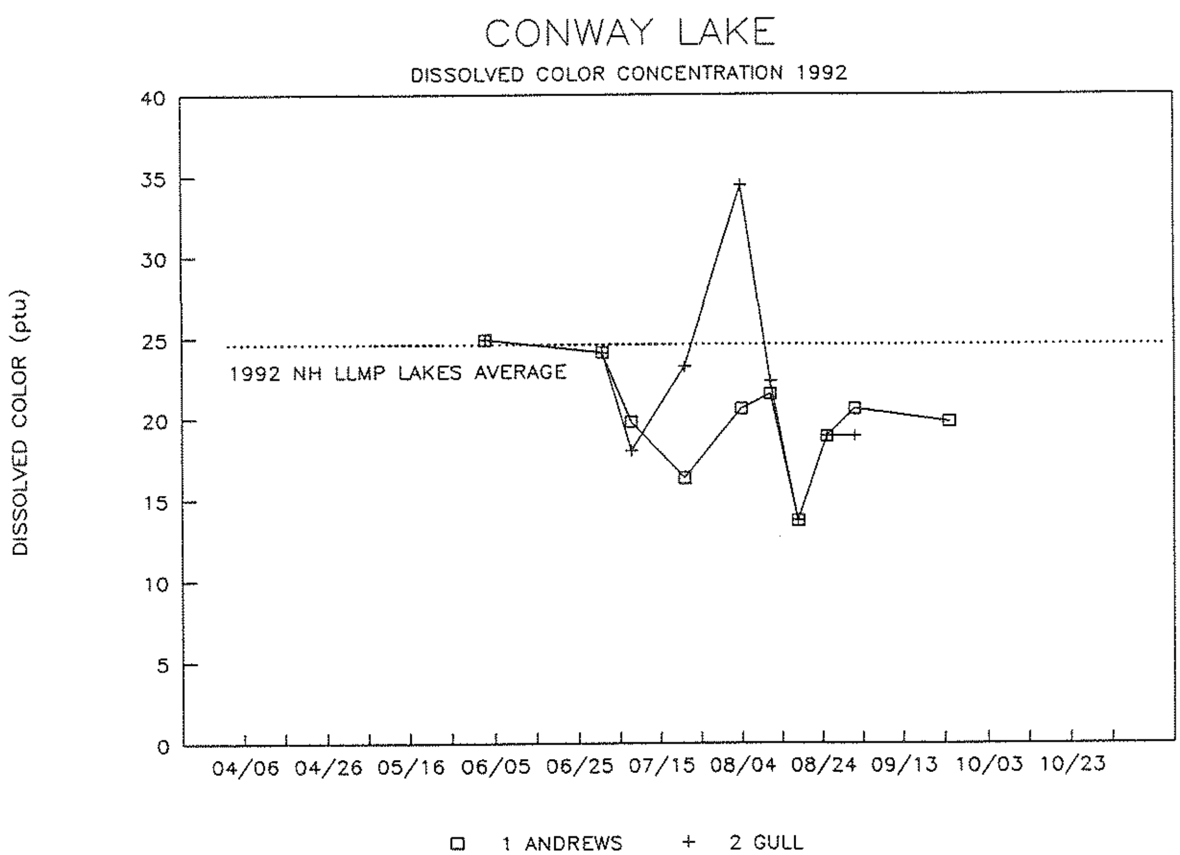
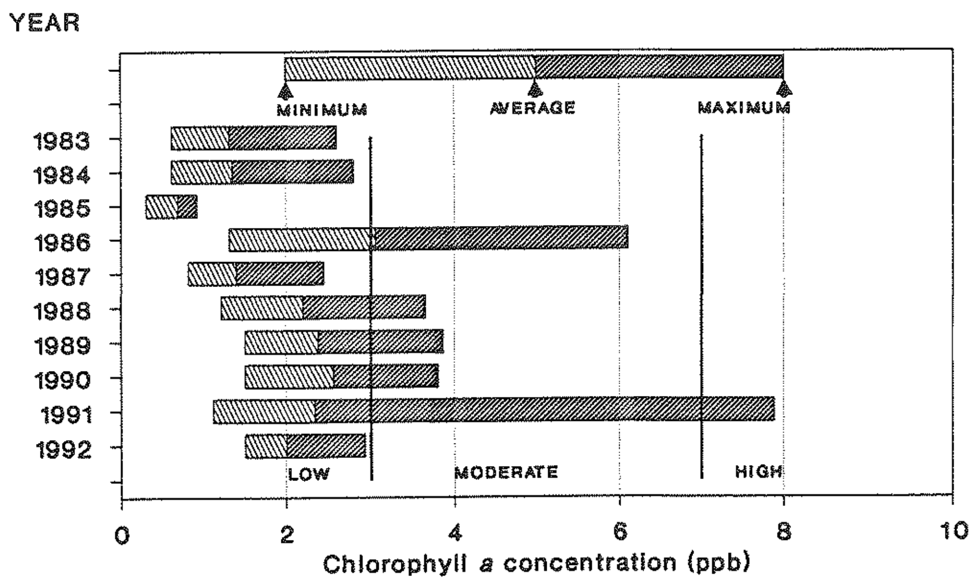

CONWAY LAKE
DISSOLVED COLOR CONCENTRATION 1992
DISSOLVED COLOR (ptu)
40
35
30
25
20
15
10
5
0
1992 NH LLMP LAKES AVERAGE
04/06 04/26 05/16 06/05 06/25 07/15 08/04 08/24 09/13 10/03 10/23
1 ANDREWS
2 GULL

Figure 12. Comparison of Conway Lake, Site 1 Andrews, 1992 lay monitor Chlorophyll *a* data with previous yearly data. The patterns of the bars display the minimum, mean and maximum values for each year sampled while the length of the bar represents the total range of values. The higher the chlorophyll *a* concentration, the more algal growth (i.e. greener water).

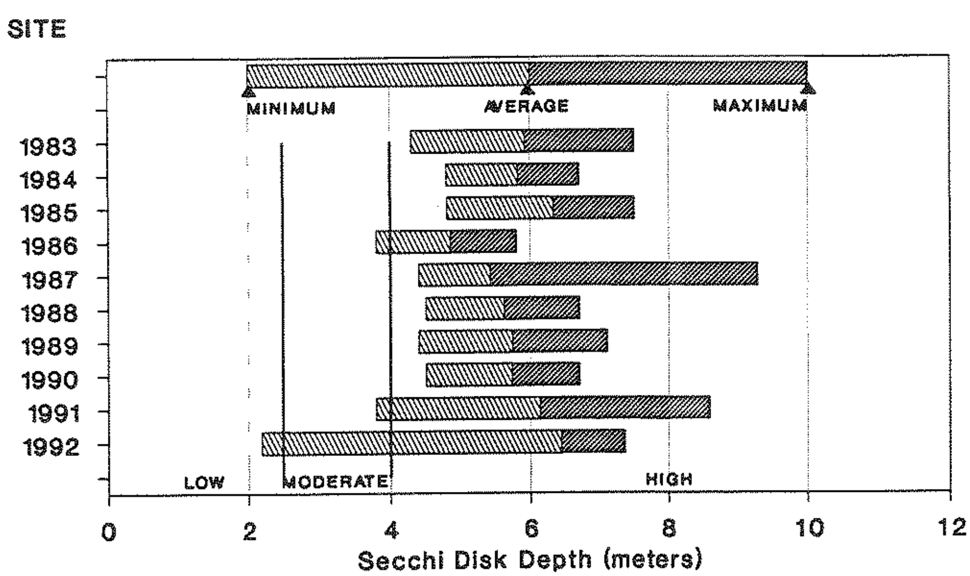
Figure 13. Comparison of Conway Lake, Site 1 Andrews, 1992 lay monitor Secchi Disk Transparency data with previous yearly data. The patterns of the bars display the minimum, mean and maximum values for each year sampled while the length of the bar represents the total range of values. The higher the secchi disk value, the clearer the lake. Secchi disk readings are taken to the nearest tenth (0.1) of a meter.

CONWAY LAKE - SITE 1 ANDREWS
YEARLY COMPARISONS OF CHLOROPHYLL *a* DATA
LAY MONITOR DATA



The higher number = more algae

CONWAY LAKE - SITE 1 ANDREWS
YEARLY COMPARISONS OF SECCHI DISK DATA
LAY MONITOR DATA

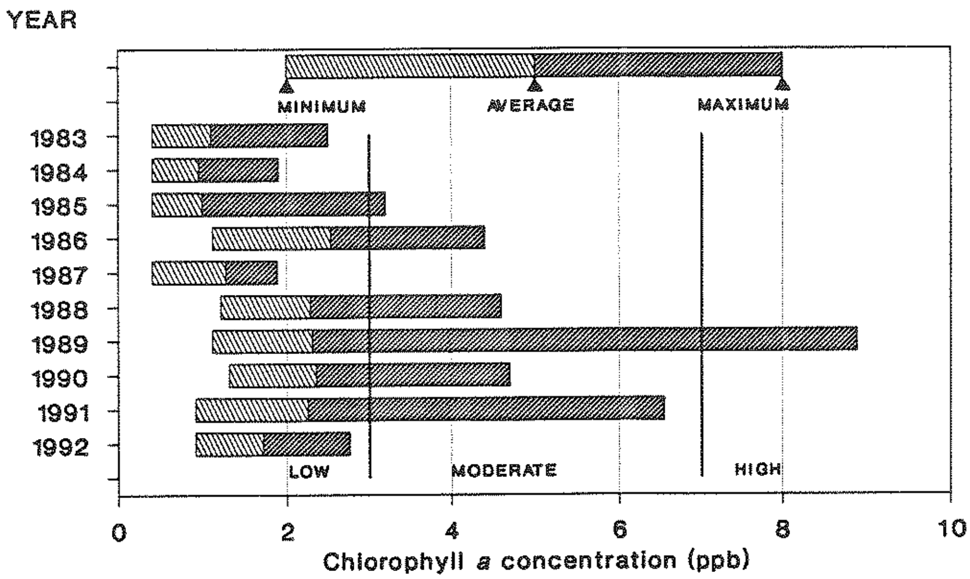


The higher number = clearer water

Figure 14. Comparison of Conway Lake, Site 2 Gull, 1992 lay monitor Chlorophyll *a* data with previous yearly data. The patterns of the bars display the minimum, mean and maximum values for each year sampled while the length of the bar represents the total range of values. The higher the chlorophyll *a* concentration, the more algal growth (i.e. greener water).

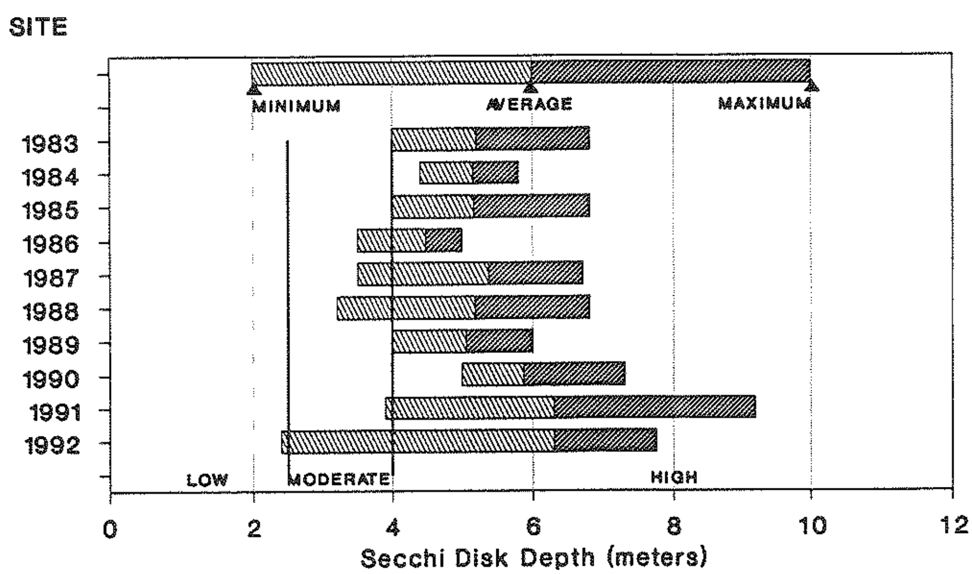
Figure 15. Comparison of Conway Lake, Site 2 Gull, 1992 lay monitor Secchi Disk Transparency data with previous yearly data. The patterns of the bars display the minimum, mean and maximum values for each year sampled while the length of the bar represents the total range of values. The higher the secchi disk value, the clearer the lake. Secchi disk readings are taken to the nearest tenth (0.1) of a meter.

CONWAY LAKE - SITE 2 GULL
YEARLY COMPARISONS OF CHLOROPHYLL *a* DATA
LAY MONITOR DATA



The higher number = more algae

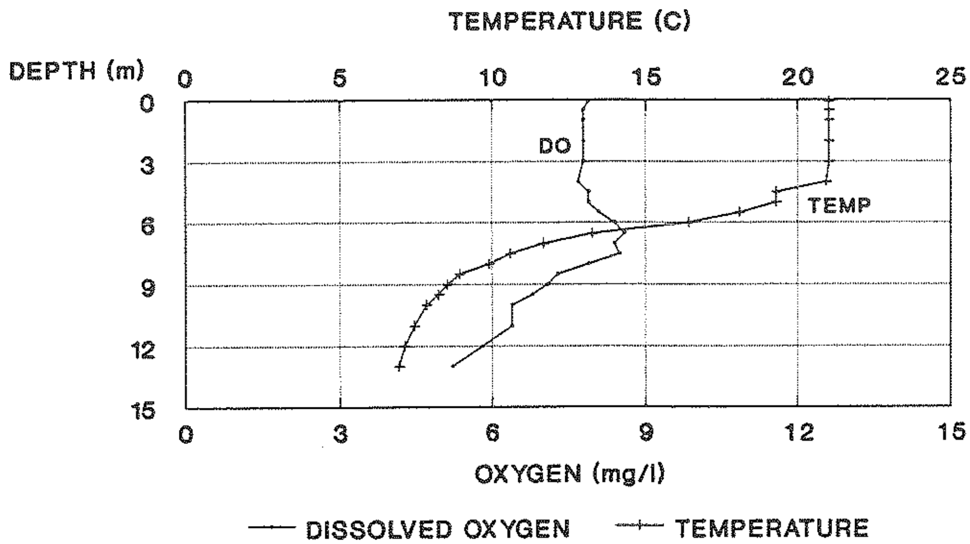
CONWAY LAKE - SITE 2 GULL
YEARLY COMPARISONS OF SECCHI DISK DATA
LAY MONITOR DATA



The higher number = clearer water

Figure 16. Profiles of temperature (TEMP) and dissolved oxygen (DO) taken on July 14, 1992 in Conway Lake (A) Site 1 Andrews and (B) Site 2 Gull. Units of measurement are as indicated on the respective graphs. Dissolved oxygen and temperature were measured at one-half meter intervals.

TEMPERATURE - OXYGEN PROFILE
CONWAY - SITE 1 ANDREWS
JULY 14, 1992



TEMPERATURE - OXYGEN PROFILE
CONWAY - SITE 2 GULL
JULY 14, 1992

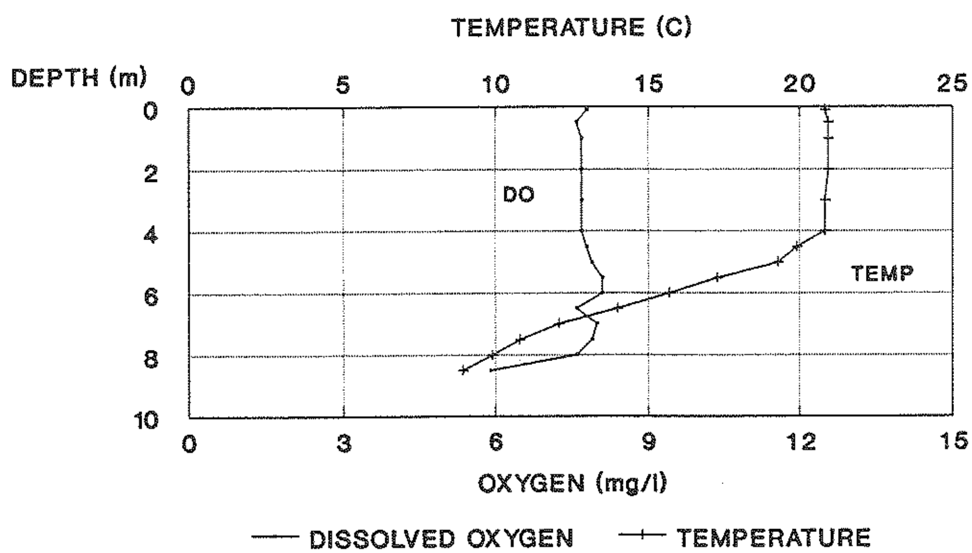
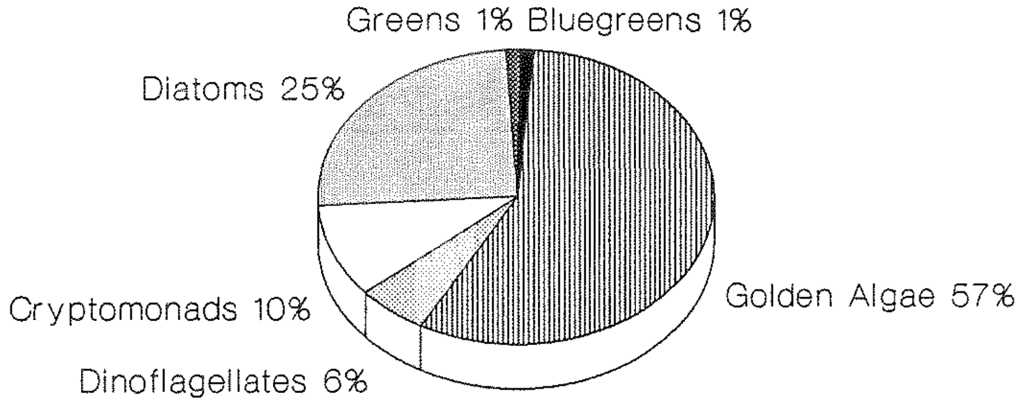


Figure 17. Pie diagrams of Phytoplankton Abundance by algal class. Phytoplankton samples collected on July 14, 1992 at the deep sampling stations 1 Andrews and 2 Gull. Phytoplankton densities are presented as relative percent by algal group.

CONWAY LAKE
SITE 1 ANDREWS
DEPTH 0-4.0 meters



SITE 2 GULL
DEPTH 0-4.0 meters

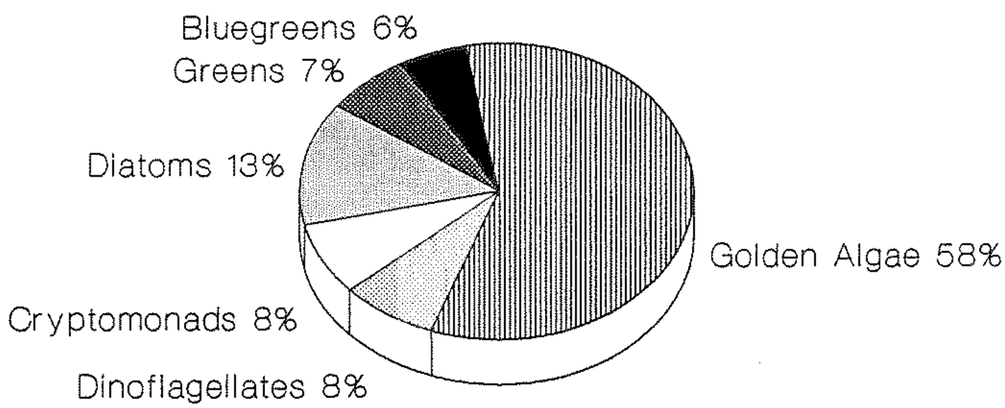
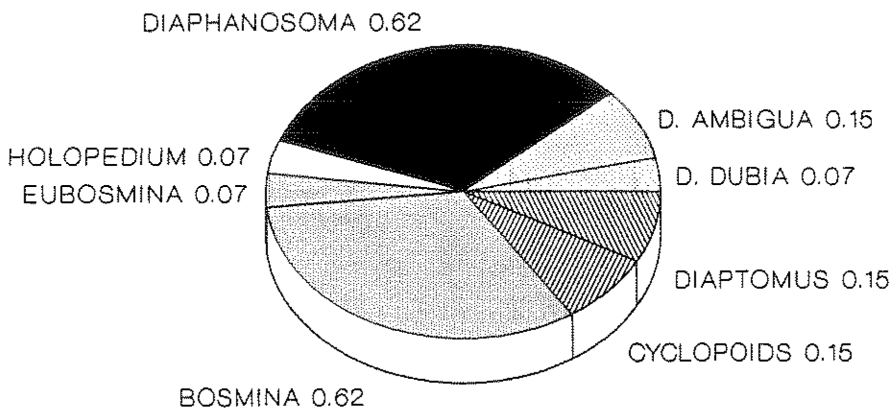
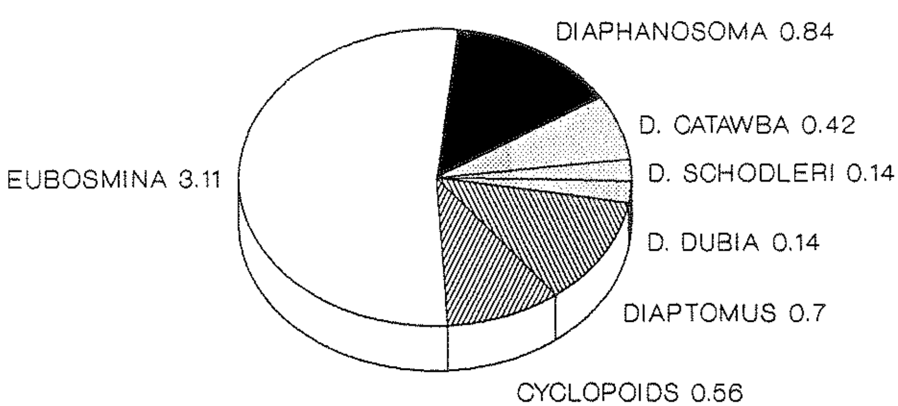


Figure 18. Pie diagrams of Macro-Zooplankton Diversity by organism for Conway Lake Sites 1 Andrews and 2 Gull. Zooplankton densities presented as number of organisms per liter of water.

1 ANDREWS
MACROZOOPLANKTON DATA 0-13.5m
7-14-92



SITE 2 GULL
MACROZOOPLANKTON DATA 0-7.5m
7-14-92



Conway Lake Data on file as of 01/04/1993

Lakes Lay Monitoring Program, U.N.H.

[Lay Monitor Data]

Conway Lake, NH
-- subset of trophic indicators, all sites, 1992

1992 SUMMARY

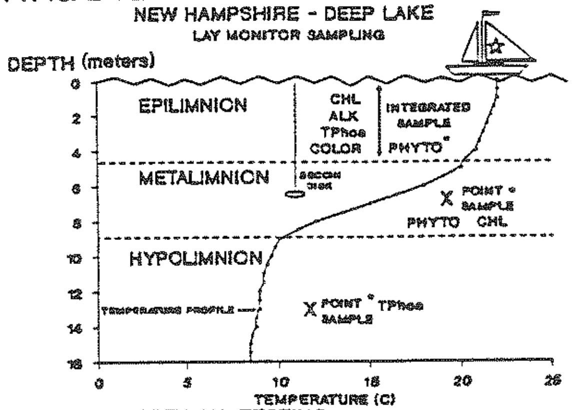
Average transparency:	6.4	(1992:	26	values;	2.2	-	7.8	range)
Average chlorophyll:	1.8	(1992:	19	values;	0.9	-	2.9	range)
Average phosphorus:	3.3	(1992:	2	values;	3.1	-	3.5	range)
Average alk (gray):	3.4	(1992:	15	values;	2.6	-	4.3	range)
Average alk (pink):	3.7	(1992:	15	values;	2.9	-	4.8	range)
Average color, 440:	21.0	(1992:	19	values;	13.7	-	34.4	range)
Average Trib. phos:	6.8	(1992:	5	values;	3.5	-	14.6	range)

Site	Date	Trans-parency (m)	Chl a (ppb)	Total Phos (ppb)	Alk. (gray) ph 5.1	Alk. (pink) ph 4.6	Color Pt-Co units
1 Andrews	06/03/1992	6.2	1.6	---	3.6	4.0	24.9
1 Andrews	06/11/1992	6.2	---	---	---	---	---
1 Andrews	06/17/1992	5.5	---	---	---	---	---
1 Andrews	07/01/1992	2.2	2.4	---	4.3	4.7	24.1
1 Andrews	07/08/1992	6.3	2.2	---	---	---	19.8
1 Andrews	07/21/1992	6.8	2.0	---	---	---	16.3
1 Andrews	08/04/1992	7.8	1.6	---	3.3	3.7	20.6
1 Andrews	08/11/1992	7.3	1.6	---	3.3	3.6	21.5
1 Andrews	08/18/1992	7.0	1.7	---	3.0	3.4	13.7
1 Andrews	08/25/1992	6.8	2.4	---	2.9	3.2	18.9
1 Andrews	09/01/1992	7.8	1.5	---	2.9	3.3	20.6
1 Andrews	09/16/1992	7.2	---	---	---	---	---
1 Andrews	09/24/1992	6.8	2.9	3.5	2.6	2.9	19.8
2 Gull	06/03/1992	6.0	1.5	---	4.2	4.8	24.9
2 Gull	06/11/1992	6.0	---	---	---	---	---
2 Gull	06/17/1992	5.5	---	---	---	---	---
2 Gull	07/01/1992	2.4	2.7	---	4.1	4.5	24.1
2 Gull	07/08/1992	6.2	2.1	---	---	---	18.0
2 Gull	07/21/1992	6.8	1.6	---	---	---	23.2
2 Gull	08/04/1992	6.5	1.6	---	3.9	4.4	34.4
2 Gull	08/11/1992	7.1	1.4	---	3.2	3.5	22.3
2 Gull	08/18/1992	7.0	1.6	---	3.1	3.5	13.7
2 Gull	08/25/1992	7.1	1.6	---	3.0	3.3	18.9
2 Gull	09/01/1992	7.8	0.9	---	2.9	3.3	18.9
2 Gull	09/16/1992	7.1	---	---	---	---	---
2 Gull	09/24/1992	6.5	---	3.1	---	---	---
McQuade Br	09/28/1992	---	---	5.3	---	---	---
T-1 Snow	09/28/1992	---	---	6.2	---	---	---
T-2 Willey	09/28/1992	---	---	4.2	---	---	---
T-5 Clark	09/28/1992	---	---	3.5	---	---	---
T-6 Page	09/28/1992	---	---	14.6	---	---	---

Conway Lake Data on file as of 01/04/1993

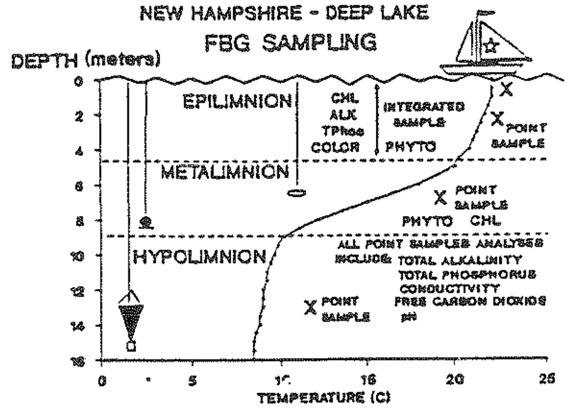
<< End of 1992 listing, 31 records >>

TYPICAL TEMPERATURE CONDITIONS : SUMMER
NEW HAMPSHIRE - DEEP LAKE
LAY MONITOR SAMPLING



* - INDICATES OPTIONAL TESTING

TYPICAL TEMPERATURE CONDITIONS : SUMMER
NEW HAMPSHIRE - DEEP LAKE
FBG SAMPLING



TYPICAL TEMPERATURE CONDITIONS : SUMMER
NEW HAMPSHIRE - DEEP LAKE